

REMARKS

Claims 1 and 11 have been amended. Claim 4 has been cancelled. Claims 13-17 have been added. Claims 1-3 and 5-17 are pending in this case. Reexamination and reconsideration with respect to the claims as amended and added are respectfully requested.

The Examiner rejected claims 1-4, 7, 10 and 11 under 35 U.S.C. §102(b) as anticipated by Maarschalkerweerd. This rejection is respectfully traversed.

The present invention is directed to an ultraviolet (UV) ray irradiation apparatus of the type employed for sterilizing bacteria and other contaminants in a liquid which flows past UV light irradiating tubes. Fouling of the tubes occurs over time due to accumulation of contaminants. This is a serious problem since it impedes the efficiency of the UV light ray treatment of the liquid, which can cause unacceptable rises in bacteria content. The UV ray irradiation apparatus of the present invention provides a system for removing these contaminants from the outer surface of the tubes by synergistically combining the mechanical cleaning action of a scraper ring which is slid over the outer surface of the tube with the chemical action of a chemical cleaning solution which circulates inside the scraper ring as the scraper ring is reciprocated over the surface of the tube.

As further set out in claim 1 as amended, the scraper ring is reciprocated over the outer surface of the tube by a

mechanical means. (In a preferred embodiment, this mechanical means comprises a screw stem mounted to a frame.) This facilitates keeping the overall size of the cleaning mechanism relatively small thereby reducing interference with the radiation capability of the light transmitting tubes.

An additional advantageous feature of the present invention is the compact size of the scraper rings which allows the majority of the surface area of the tube to be exploited for irradiation of the liquid. This compact size scraper ring is nonetheless able to provide the synergistic cleaning action mentioned above due to the combination of an annular shaped chamber within the scraper ring and a means for introducing the cleaning solution so that it circulates about the tube surface in an annular manner (as set out in claim 11 as amended).

The Maarschalkerweerd '370 reference is directed to a light irradiating apparatus having a cleaning system which employs hydraulically operated cleaning sleeves. A cleaning solution is employed as one of the two fluids used for the dual hydraulic action of each cleaning sleeve. Although Maarschalkerweerd addresses the same problem as the present invention, cleaning of light irradiating tubes, that reference has a number of disadvantages over the present invention. For example, as will be appreciated from inspection of Figure 4 of that reference, the cleaning sleeve 228 is large and covers a substantial surface area which could otherwise be used for irradiating the liquid to be treated. The large size of the cleaning sleeve is in part due

to the unnecessarily complex hydraulic actuation system for the sleeves which system is duplicated for each cleaning sleeve situated on each tube. Although an alternate embodiment of the Maarschalkerweerd reference, shown in Figures 6 and 7 thereof, discloses a smaller cleaning solution chamber 316 annularly arranged about the translucent tube to be cleaned, nonetheless the hydraulic actuation mechanism is just as large as in the principle embodiment. Therefore, in this alternative embodiment the hydraulic mechanism would still interfere with UV light irradiation of the liquid. Indeed, as shown in Figure 6, the useful length of the light irradiating tube is only approximately half the overall length of the apparatus.

Also, although the Maarschalkerweerd reference does employ both a mechanical and chemical "cleaning action" that reference does not obtain the synergy which is potentially available in combining these two cleaning actions, such as is achieved by the present invention. For example, as discussed at column 7, lines 14-27 of Maarschalkerweerd, the cleaning sleeve is moved to its extended position over the UV light emitting tube and retained there while the chemical solution decomposes material on the surface of the tube. After a selected period of time, the cleaning sleeve is retracted and a sweeping action occurs as the sleeve is retracted. Therefore, the Maarschalkerweerd reference isolates the chemical and mechanical effects to a large degree and fails to fully exploit the synergy between the chemical and mechanical cleaning actions. In contrast, the present invention

feeds cleaning solution into the chamber while the scraper ring is reciprocated, thereby maximizing the synergistic effect of the scraping and chemical cleaning actions.

In view of the foregoing, it will be appreciated that the Maarschalkerweerd reference fails to disclose or suggest the present invention as set out in claim 1 as amended.

Specifically, Maarschalkerweerd does not disclose the compact configuration of the cleaning apparatus of the present invention, employing mechanical means for reciprocating the scraper ring over the light transmission tubes. Maarschalkerweerd also fails to disclose or suggest the synergistic action achieved by reciprocating the scraper rings while the cleaning solution is introduced into the cleaning solution chamber. These features are clearly recited in claim 1 as amended.

Also, the Maarschalkerweerd reference fails to disclose or suggest the features set out in the dependent claims. In particular, claim 11 as amended recites an annular cleaning solution chamber wherein the means for providing the chemical solution introduces the chemical solution so as to flow annularly about the tube in the annular chamber. This further enables the compact size of the overall apparatus while maintaining an effective synergistic cleaning action. This feature is neither disclosed nor suggested by Maarschalkerweerd.

The Examiner rejected claims 5, 6, 8 and 9 under 35 U.S.C. §103(a) as being unpatentable over Maarschalkerweerd in view of Ellner, et al. This rejection is respectfully traversed.

The Ellner, et al. reference cited by the Examiner discloses a mechanical mechanism for moving a wiper assembly 17 over a light emitting lamp 30. In particular, the wiper assembly is actuated by a rod driven by motor 18 via a rack and gear arrangement 19. The light emitting lamps of Ellner, et al. and the wiper assembly are both located within individual radiation chambers 12 while the motor 18 is located outside the chamber. The Ellner, et al. mechanism is thus not adapted to be immersed in a flowing liquid as in the case of the Maarschalkerweerd reference or the present invention.

Furthermore, since the Ellner, et al. reference is directed to a sealed irradiation chamber approach whereas the Maarschalkerweerd reference and the present invention are directed to an apparatus adapted to be immersed in a flowing liquid environment, there would not be any motivation for one skilled in the art to combine the mechanical wiper actuation mechanism of Ellner, et al. with the system of Maarschalkerweerd. In particular, the sealed chamber 12 of Ellner, et al. allows the motor 18 to be configured outside so that the problem of potentially immersing the motor in the fluid to be treated does not arise. In the case of the Maarschalkerweerd reference, the actuation mechanism is adapted to be immersed in the fluid but is a hydraulic actuation mechanism having the disadvantages discussed above.

The present invention in contrast, overcomes this problem by configuring the driving means above the fluid to be treated via

the use of a frame coupled to the scraper rings. This allows the actuation force to be transmitted from the drive means above the fluid to the individual scraper ring(s) configured in the fluid to be treated. It is respectfully submitted this approach would not at all be obvious to one skilled in the art in view of Maarschalkerweerd where the actuation and associated cleaning mechanism are adapted to be submersed in the fluid to be treated and Ellner, et al. where a sealed chamber is employed. This distinguishing aspect of the present invention is clearly set out in added claim 14.

Also, the Ellner, et al. reference fails to disclose or suggest in any way that a cleaning solution chamber could be associated with the wiper assembly 17. Therefore, Ellner, et al. clearly fails to disclose or suggest the synergistic combination of reciprocating a wiper assembly or other mechanical cleaning mechanism while at the same time introducing a cleaning solution into a cleaning solution chamber. Therefore, the Ellner, et al. reference fails to provide this deficiency of the Maarschalkerweerd reference discussed above.

The Examiner rejected claim 12 under 35 U.S.C. §103(a) as being unpatentable over Maarschalkerweerd and Ellner, et al. as applied to claims 5, 6, 8 and 9 above, and further in view of Wood. This rejection is respectfully traversed.

The Wood reference is directed to a UV irradiation apparatus adapted to be inserted into a flow channel 12 (as shown in Figure 1 of Wood). The cleaning mechanism is mounted on frame 50 which

is slidable along jackets 34. The approach to cleaning in Wood is a purely mechanical action, i.e., use of mechanical wiper gland 54. The wiper plate 50 and associated mechanical wiper glands are reciprocated via a pneumatic motor 64. Pneumatic motor 64 is operated by providing pressurized air to one side or the other of piston 68 while the opposite side is exhausted by a switching valve (column 7, lines 7-10). Although Wood specifically discusses that alternative motors may be employed, the only reference to such an alternative is to a hydraulic motor (column 8, lines 8-29). Therefore, if anything, the Wood reference in combination with the Maarschalkerweerd reference suggests that pneumatic or hydraulic actuation systems are the only type suitable for an open channel fluid flow type of application since they may be immersed in the fluid. The Wood reference thus teaches away from the combination of Maarschalkerweerd and Ellner, et al. as proposed by the Examiner.

Furthermore, since the Wood reference fails to suggest in any way the use of a chemical cleaning solution chamber or the synergistic combination of chemical and mechanical cleaning actions, the Wood reference also fails to disclose or suggest the deficiencies of the Maarschalkerweerd reference discussed above. Accordingly, it is respectfully submitted that not only does the Wood reference teach away from, rather than toward, the three-way combination proposed by the Examiner, but even if combined as proposed would not result in the present invention as claimed.

Accordingly, it is respectfully submitted that the above-noted rejections are fully traversed.

In addition, new independent claims 15 and 17 have been added to further clarify the present invention and distinguish the cited references.

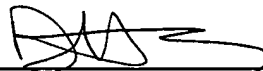
In particular, added independent claim 15 and dependent claim 16 are directed to the aspect of the present invention that a plurality of the transmission tubes may be cleaned by actuating a plurality of scraper rings which are reciprocated together and fed by a common comoving chemical cleaning solution supply means. Although it is respectfully submitted that this feature is clearly shown in the drawings as filed, a minor amendment to Figure 2 and a clarifying amendment to the specification have been added to make this feature more readily apparent. No new matter has been added.

It is respectfully submitted that this aspect of the present invention is neither disclosed nor suggested by the cited references. In particular, the Maarschalkerweerd reference shows separate actuation mechanisms and separate fluid supply means for each cleaning sleeve of each tube. This is clearly a far more complicated mechanism for cleaning the tubes and furthermore necessarily interferes with the tube surface area available for irradiating the fluid to be treated. The remaining references fail to disclose any use of a chemical cleaning solution chamber at all and certainly fail to disclose the present invention as set out in added claim 15.

New claim 17 in turn provides a method claim which sets out the synergistic cleaning capability provided by the present invention by reciprocating mechanical scraper rings over the tubes while at the same time introducing a cleaning solution to the chamber so as to flow around the tubes. In view of the above discussion, it will be appreciated that the Maarschalkerweerd reference fails to disclose or suggest this feature. Accordingly, it is respectfully submitted that method claim 17 also clearly distinguishes the cited references.

In view of the foregoing, it is respectfully submitted that all claims clearly distinguish the cited references and are in condition for allowance. Reexamination and reconsideration are respectfully requested and allowance at an early date is solicited.

Respectfully submitted,



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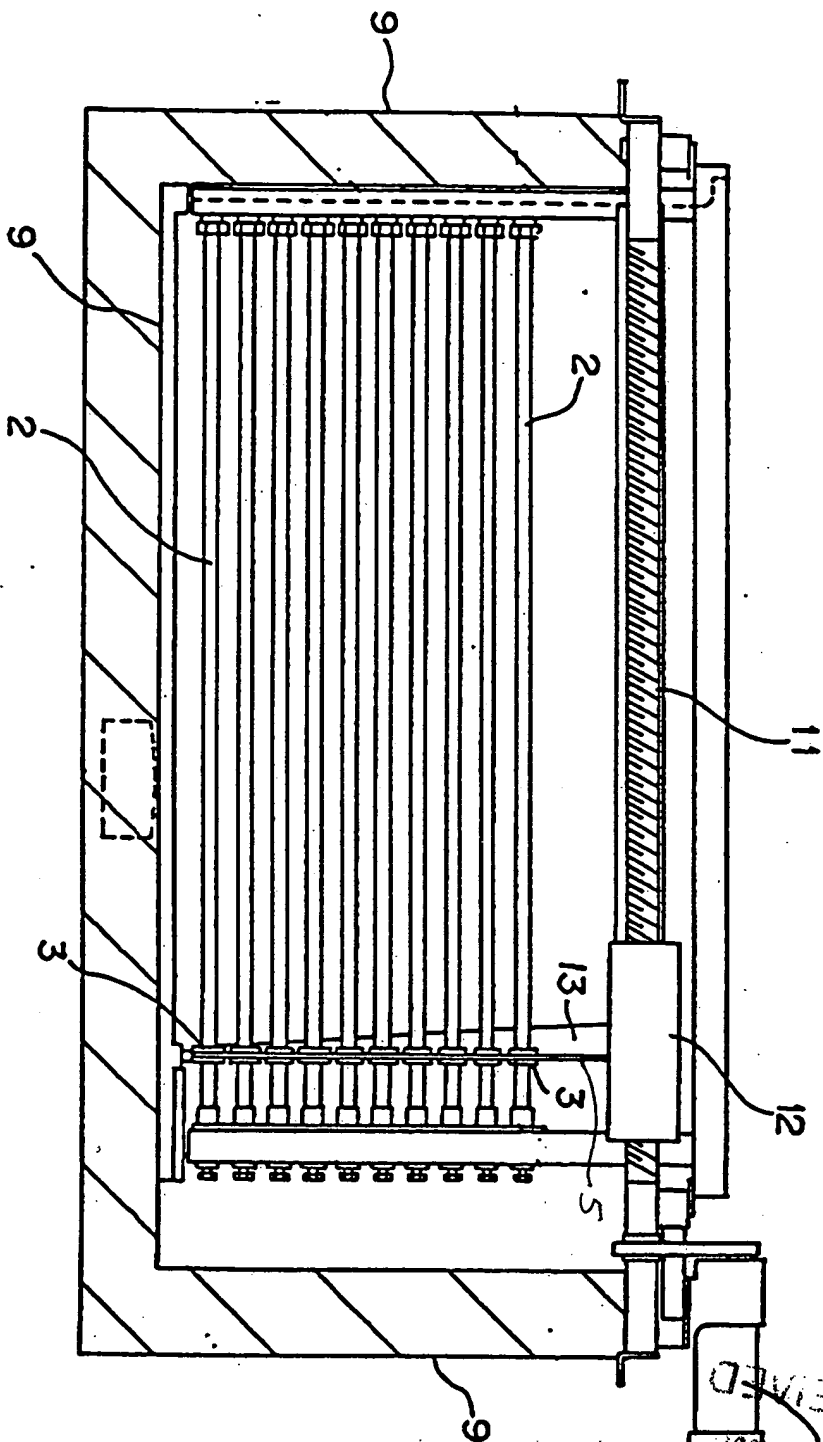
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Figure 2



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